



National Transportation Safety Board Aviation Accident Final Report

Location:	DENVER, CO	Accident Number:	FTW95LA170
Date & Time:	04/13/1995, 2226 MDT	Registration:	EICEU
Aircraft:	BOEING 737-400	Aircraft Damage:	Substantial
Defining Event:		Injuries:	147 None
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Analysis

THE APPROACH BRIEFING, RADIOS, INSTRUMENTS, AND SPEED BUGS WERE SET UP FOR A PLANNED LANDING ON RUNWAY 17R. THE FIRST OFFICER, WHO WAS FLYING, INADVERTENTLY ALIGNED THE AIRPLANE WITH RUNWAY 17L AND THE FLIGHT WAS SUBSEQUENTLY CLEARED TO LAND ON THAT RUNWAY. AT 500 FEET AGL, THE GLIDESLOPE AURAL WARNING SOUNDED. AT 100 FEET, THE GROUND PROXIMITY WARNING SYSTEM'S SINK RATE WARNING SOUNDED, AND THE FIRST OFFICER ADDED POWER. AT 50 FEET AND OVER THE RUNWAY THRESHOLD, AIRSPEED DETERIORATED. THE FIRST OFFICER APPLIED ADDITIONAL POWER AND THE CAPTAIN ADDED MAXIMUM THRUST AND FORWARD CONTROL YOKE PRESSURE. ACCORDING TO THE CREW, 'A HARD LANDING WAS MADE.' A REVIEW OF CONTROL TOWER TAPES REVEALED THE WINDS VARIED FROM 180 TO 200 DEGREES AND 10 TO 27 KNOTS. MOMENTS BEFORE THE FLIGHT LANDED, ANOTHER LANDING AIRPLANE REPORTED A 10-KNOT LOSS OF AIRSPEED AT 100 FEET. THE AIRPLANE SUSTAINED DAMAGE TO THE PRESSURE VESSEL AND STRUCTURAL STRINGERS.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: PROPER DESCENT RATE NOT MAINTAINED BY THE FIRST OFFICER, RESULTING IN A HARD LANDING. FACTORS WERE UNFAVORABLE WIND CONDITIONS AND THE CAPTAIN'S INADEQUATE SUPERVISION OF THE FIRST OFFICER.

Findings

Occurrence #1: HARD LANDING

Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings

1. (C) PROPER DESCENT RATE - NOT MAINTAINED - COPILOT/SECOND PILOT
2. (F) WEATHER CONDITION - UNFAVORABLE WIND
3. (F) SUPERVISION - INADEQUATE - PILOT IN COMMAND

Factual Information

On April 13, 1995, at 2226 mountain daylight time, a Boeing 737-4Y0, EI-CEU, was substantially damaged during landing at Denver, Colorado. There were no injuries to the 141 passengers, 4 cabin attendants, and two cockpit crewmembers aboard. Visual meteorological conditions prevailed.

The airplane was being operated by MarkAir, Inc., as flight 523, scheduled domestic passenger service from Kansas City, Missouri, to Denver, Colorado. According to a joint written statement submitted by the captain and the first officer, the flight proceeded uneventfully and the approach briefing, radios, instruments, and speed bugs (Vref, 136 KIAS; target speed, 145 KIAS; Vref+15, 151 KIAS, based on a landing weight of 112,000 pounds) were set up for a planned landing on runway 17R. The first officer was flying the airplane.

After the airplane had been positioned on the downwind leg, the crew was offered the option of landing on runway 16. This was accepted but when told they could expect a delay to that runway, they requested and were cleared for a visual approach to, and landing on, runway 17R.

ATIS (automatic terminal information service) indicated the winds to be from 190 degrees at 18 knots. A surface weather observation in effect at the time indicated the winds were from 180 degrees at 19 knots. The first officer, who was flying the airplane, lined up with runway 17L and when the mistake was realized, they requested and were cleared to land on runway 17L. This paragraph is based on the crew's enclosed statement. The airport was visible to the crew. The lights for runway 17L were set on high intensity; the lights for runway 17R were not visible. The airplane was aligned with the visible runway lights: PAPI (precision approach path indicator) lights and glideslope indications agreed with each other. When there was no localizer capture, the crew realized they were lined up with runway 17L. The flight was subsequently cleared to land on runway 17L. At 500 feet AGL (above ground level), the glide slope aural warning sounded and was cancelled because the radios had been tuned to the nav aids serving the parallel runway. At 100 feet AGL, the GPWS (ground proximity warning system) sink rate warning sounded, and the first officer added power. At 50 feet AGL and over the runway threshold, airspeed deteriorated. The first officer applied additional power and the captain added maximum thrust and forward control yoke pressure. "A hard landing was made."

During its preflight inspection, the relief flight crew noticed damage to the airplane that included a compromised pressure vessel, a crushed tail skid, breaches in the skin with associated stringer damage, and a collapsed right main landing gear strut. The crew flying "did not suspect any external damage to the aircraft until arriving at the gate and being told by ground personnel."

The data from the airplane's digital flight data recorder (DFDR) was read out and evaluated. According to the group chairman's factual report, vertical acceleration spiked at 3.64 g's when the airplane contacted the runway. The report added that due to accelerometer characteristics and DFDR sampling rate, this value could be greater or less than the actual g's incurred. The factual report and the DFDR Data in Graphical Format are attachments to this report. Data supporting these documents are on record with the Safety Board's Office of Research and Engineering.

A review of the control tower audio tapes revealed the following (all times are approximate):

2218:41 Frontier 706, cleared to land, runway 17R. Wind 190 degrees at 16 knots.

2221:50 United 776, cleared to land, runway 16. Wind 190 degrees at 10 knots.

2222:01 MarkAir 523, cleared to land, runway 17R. Wind 200 degrees at 18 knots.
Wind check for runway 16 approach end, wind 190 degrees at 25 knots.

2222:36 UPS 841, cleared for takeoff, runway 17R. Wind 200 degrees at 18 knots.

2223:37 Wind check, 190 degrees at 27 knots. Runway 17R, wind 200 degrees at 20 knots.

2224:12 United 358, cleared to land, runway 16. Wind 180 degrees at 25 knots.

2225:06 Cactus 491, cleared to land, runway 16. Wind 180 degrees at 25 knots.

2225:40 MarkAir 523, you're lined up with runway 17L. Cleared to land, runway 17L.

2225:49 United 776 reports a 10 knot loss of airspeed at 100 feet.

2226:23 Cactus 491 advises it will be "real careful."

2226:38 United 242, cleared for takeoff, runway 17R. Wind 200 degrees at 18 knots.

2227:02 MarkAir 523 is given initial taxi instructions.

The following is a portion of the recorded ATIS (automatic terminal information service) in effect at the time of the incident:

Denver International Airport, Automated Weather Arrival, Information Alpha, zero three five five zulu, temperature five five, dew point three zero, wind one eight zero at one niner, altimeter two niner eight five...

Pilot Information

Certificate:	Airline Transport; Commercial	Age:	39, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land; Single-engine Sea	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	Last FAA Medical Exam:	11/18/1994
Occupational Pilot:	Last Flight Review or Equivalent:		
Flight Time:	9800 hours (Total, all aircraft), 4500 hours (Total, this make and model), 7900 hours (Pilot In Command, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	BOEING	Registration:	EICEU
Model/Series:	737-400 737-400	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	24345
Landing Gear Type:	Retractable - Tricycle	Seats:	169
Date/Type of Last Inspection:	04/05/1995, AAIP	Certified Max Gross Wt.:	142500 lbs
Time Since Last Inspection:	133 Hours	Engines:	2 Turbo Fan
Airframe Total Time:	14505 Hours	Engine Manufacturer:	CFM
ELT:	Not installed	Engine Model/Series:	CFM-56
Registered Owner:	GPA FINANCE, LTD.	Rated Power:	23500 lbs
Operator:	MARKAIR, INC.	Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	MRKA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Night/Dark
Observation Facility, Elevation:	DEN, 5431 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	2155 MDT	Direction from Accident Site:	0°
Lowest Cloud Condition:	Clear / 0 ft agl	Visibility	7 Miles
Lowest Ceiling:	None / 0 ft agl	Visibility (RVR):	0 ft
Wind Speed/Gusts:	/	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29 inches Hg	Temperature/Dew Point:	13° C / -1° C
Precipitation and Obscuration:			
Departure Point:	KANSAS CITY, MO (MCI)	Type of Flight Plan Filed:	IFR
Destination:		Type of Clearance:	IFR
Departure Time:	2142 CDT	Type of Airspace:	Class B

Airport Information

Airport:	DENVER INTERNATIONAL (DEN)	Runway Surface Type:	Concrete
Airport Elevation:	5431 ft	Runway Surface Condition:	Dry
Runway Used:	17L	IFR Approach:	Visual
Runway Length/Width:	12000 ft / 150 ft	VFR Approach/Landing:	Full Stop

Wreckage and Impact Information

Crew Injuries:	6 None	Aircraft Damage:	Substantial
Passenger Injuries:	141 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	147 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	ARNOLD W SCOTT	Report Date:	09/24/1995
Additional Participating Persons:	ARTHUR MARTINEZ; DENVER, CO		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinquiry@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).